

Stubbs, Observer United States Weather Bureau, Santo Domingo, reports:

While in the harbor of Monte Christo, Captain Garvin, of the Clyde Line, was told by the captain of the Norwegian bark, *Linnea*, that in running from Bahia, Brazil, for Barbados he got too far west and made St. Lucia. He then beat to the northward and on Sunday, May 11, was within 15 miles of Martinique, which, however, he could not see as it seemed surrounded by a cloud. No ashes were observed on this date. He arrived at Barbados on May 14, and early in the morning of that day  $1\frac{1}{2}$  inches of volcanic dust fell on the *Linnea's* deck.

#### THE VARIATION OF TERRESTRIAL GRAVITY OVER THE OCEAN.

As is well known, the study of the mechanics of the earth's atmosphere has usually been complicated by an effort to take account of the so-called viscosity of the air. In an article in the American Meteorological Journal for 1893, it has been shown that the irregular variations of gravity are of equal importance with viscosity. Meteorologists are therefore interested in every effort to determine the actual force of gravity, and in the MONTHLY WEATHER REVIEW for 1895, we have given the results of the work of the Coast and Geodetic Survey, so far as it relates to the surface of the United States. Up to the present time although the force of gravity has been measured on small islands in the ocean, yet nothing has been known as to its value at the surface of the ocean far from land. On this point our first knowledge is that given by F. R. Helmert, Director of the Royal Geodetic Institution at Berlin. In his annual report for April, 1902, he says:

The measurements of relative gravity on the ocean, as planned by myself, following Mohn's method of comparison of mercurial barometers and boiling point thermometers, has been carried out after thorough preparatory work by Dr. Hecker, along the line Hamburg-Lisbon-Rio Janeiro-Lisbon, with the assistance of the Committee on International Geodesy and the allowance of free passage on the part of the Hamburg-South American Steamship Association in the months July-October, 1901. Although the mean error of observation for a complete series (which consists of many determinations with four barometers and six thermometers during a morning or an afternoon) is much larger than the corresponding error in the case of pendulum observations, namely, about plus or minus 0.028 centimeters per second in the value of the acceleration of gravity, still it was established that on the deep ocean the acceleration of gravity certainly differs only a very few hundredths of a centimeter from that in the shallow sea near the coast, being perhaps 0.032 centimeters smaller. It can therefore no longer be maintained that the large value of  $g$  observed on the small oceanic islands extends over the ocean itself, and as little can the reverse be maintained, namely, that the ap-

parent defect of mass, in the space occupied by the sea makes itself felt by a great diminution of  $g$  relative to that on land.

In connection with the results of Nansen's polar expedition, in the northern Polar Sea, Hecker's determinations add to the probability of the general truth of the equilibrium theory of the earth's crust, as explained by Pratt. Further details are given in the Sitzungsberichte of the Berlin Academy, February, 1902, as also in the report of the work of the Central Bureau of International Geodesy for 1901. As to the accuracy of the new boiling point thermometer, see the Zeitschrift für Instrumentenkunde, 1901, p. 133.—C. A.

#### A METEOROLOGICAL LIBRARY.

If any observer wishes to acquire a very complete library of about 2,000 volumes and 3,000 pamphlets, mostly on meteorology and magnetism, he will do well to address "Madame R. von Wild, Englisch viertel No. 56, Zurich, Switzerland."

#### CORRIGENDA.

In the MONTHLY WEATHER REVIEW for June, 1902, page 309, column 1, make lines 11 and 12 read as follows:

$$vw = -\frac{c}{2} w^2 z = 2g \frac{ws}{v} = wus = -\frac{w^2 w}{2} = \text{constant},$$

by 307 and 308, introducing the value  $v^2 = 2gz$ .

In line 13, dele "not."

Make lines 15 and 16 read as follows:

$$492. \quad \text{Case I.} \quad vw = -\frac{\lambda}{k-c} \frac{c}{2} w^2 z = \text{const.}$$

$$\text{Case II.} \quad vw = -\frac{\lambda}{k} cz = \text{const.}$$

In line 20, change "these" to "the."

Make line 21 read "values in equation 490."

In line 22 insert "Case I" after "493" and between lines 22 and 23 insert the following:

$$\text{Case II.} \quad \frac{\partial u}{\partial w} + \frac{u}{w} + \frac{\partial w}{\partial z} = +\frac{c}{w^2} - \frac{c}{w^2} + 0 = 0.$$

Page 307, make equation 519 read as follows:

$$519. \quad -\frac{1}{\rho} \frac{\partial p}{\partial x} = -\frac{1}{\rho} \frac{\sigma_m}{\sigma_m} \frac{\partial B}{\partial x} = -\frac{1}{\rho} \frac{\sigma_m}{111 \ 111} G = -\frac{0.12237 G}{\rho}.$$

( $G$  is in meters.)

### THE WEATHER OF THE MONTH.

By W. B. STOCKMAN, Forecast Official, in charge of Division of Records and Meteorological Data.

#### CHARACTERISTICS OF THE WEATHER FOR JULY.

The cloudiness was everywhere above the average (decidedly so in the southern slope region) except in the South Atlantic States, Ohio Valley and Tennessee, lower Lake region, the southern Plateau region, North Dakota, Missouri Valley, and the middle Pacific coast region, in which districts the departures ranged from  $-0.2$  to  $-0.7$ . The relative humidity was normal in North Dakota; below, from 3 per cent to 7 per cent, in the South Atlantic and east Gulf States, the Florida Peninsula, and the southern Plateau and north Pacific and middle Pacific regions; elsewhere it was above the normal, in values ranging from 1 per cent to 9 per cent. The precipitation was normal in the middle Pacific coast region; below in the Atlantic and east Gulf States, Florida Peninsula, North Dakota, the middle slope, and southern Plateau regions, with departures ranging from  $-0.3$  inch to  $-3.00$  inches; elsewhere it was above the mean, with values ranging from  $+0.1$  inch to  $+2.3$  inches. The temperature was above the normal, in daily values of from  $+0.1^\circ$  to  $+1.6^\circ$  in the Middle Atlantic, South

Atlantic and east Gulf States, Florida Peninsula, Tennessee and the Ohio Valley, Lake region, upper Mississippi Valley, and the middle Pacific region; elsewhere it was below, decidedly so in New England and the Plateau and middle slope regions, where the daily departures amounted to from  $-2.1^\circ$  to  $-3.7^\circ$ . Strong winds were infrequent but where they occurred, as a rule, the velocities were unusually high.

#### PRESSURE.

The distribution of monthly mean pressure is shown graphically on Chart IV and the numerical values are given in Tables I and VI.

The area inclosed within the isobar of 30.00 inches of monthly mean pressure included the Middle Atlantic, South Atlantic, east Gulf, and eastern part of the west Gulf States, the central Mississippi and Ohio valleys and the lower Lake region; also the western parts of Washington and Oregon and northwestern California. The highest monthly mean pressures reported were but slightly above 30.05 inches, and occurred

from West Virginia and eastern Kentucky southward over Florida; and also in southwestern Washington and northwestern California. The lowest monthly mean pressures were reported from the southern Plateau region, where the mean for the month was below 29.80 inches. The monthly mean pressure was slightly above the normal from Texas eastward over Florida and northeastward over the lower Lakes and New England, the greatest departures from the normal being +.06 inch; the pressure was also slightly above the normal from eastern Oregon and southwestern Idaho southward over southern California; elsewhere the mean monthly pressure was below the normal, the departures, however, not being very marked except in the Dakotas and eastern Montana, where they ranged from -.05 inch to -.09 inch. From eastern South Dakota and western Minnesota northwestward over northeastern Washington the pressure diminished slightly from June, 1902; elsewhere the pressure increased, and over the greater part of the country to a marked degree, especially over the Southern States, where the changes generally exceeded .10 inch.

#### TEMPERATURE OF THE AIR.

The distribution of monthly mean surface temperature, as deduced from the records of about 1,000 stations, is shown on Chart VI.

The mean temperature for the month was above the normal on the central and northern coasts of California, in northern Minnesota, eastern North Dakota, northeastern South Dakota, Missouri, Arkansas, western Mississippi, eastern Louisiana, and the lower Rio Grande Valley, and, excepting in New York State near Lake Ontario and the extreme southern part of Florida, over the entire region between the seventy-fifth and ninetieth meridians of longitude. The greatest daily excesses ranged from +2° to +4° and occurred in northeastern Michigan, northern and western North Carolina, southeastern Tennessee, and eastern Alabama; elsewhere it was below the normal, and generally the deficiencies were quite marked, in the territory embraced by the one hundred and fifth and one hundred and twentieth meridians ranging from -2° to more than -4°. The isotherm of 80° of mean temperature passes westward along the thirty-sixth parallel, and southward along the one hundred and first meridian, and its trend is far to the southward and considerably to the eastward of its position in July, 1901. The trend westward of the isotherm of 70° of mean temperature was about the same as during July, 1901, but its southerly trend lay somewhat to the eastward, and west of the one hundredth meridian, considerably to the southward of its position for July, 1901. The region of maximum temperatures of 100°, or slightly higher, embraced the South Atlantic and east Gulf States, generally, western Tennessee, the lower Ohio Valley, portions of Texas, Indian Territory, New Mexico, the northern and southern Plateau, and the interior of the Pacific regions, whereas in July, 1901, it comprised practically the entire United States. Maximum temperatures of 110° or higher occurred in western Arizona and the interior of California, in the latter extending much farther to the northward than in 1901. East of the ninety-fifth meridian, and in Kansas, Oklahoma, Indian Territory, and Texas the mean minimum temperatures were about the same as during July, 1901, but over the remaining districts they were lower. Temperatures of 32°, or lower, occurred at elevated points in the mountain districts only.

*In Canada*—Prof. R. F. Stupart says:

The temperature was about average in Manitoba and in Ontario east as far as the Muskoka district, and south to Lake Ontario, including all the peninsula excepting the north shores on Lake Erie. The greatest plus departures, amounting to from 3° to 4°, occurred over the Strait of Mackinac and in the Georgian Bay region. Elsewhere in Canada the temperature varied from average to 4° below, the chief negative departures being reported in northern British Columbia and in Assiniboia.

The average temperature for the several geographic districts and the departures from the normal values are shown in the following table:

*Average temperatures and departures from normal.*

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England.....	8	65.7	-2.1	+4.0	+0.6
Middle Atlantic.....	12	74.9	+0.2	+2.5	-0.4
South Atlantic.....	10	81.5	+1.6	+6.7	-1.0
Florida Peninsula.....	8	82.2	+0.8	+4.2	-0.6
East Gulf.....	9	82.4	+1.4	+2.7	-0.4
West Gulf.....	7	81.3	-0.5	+2.4	+0.8
Ohio Valley and Tennessee.....	11	77.8	+0.9	+6.0	-0.9
Lower Lake.....	8	71.6	+0.4	+0.4	-1.9
Upper Lake.....	10	68.7	+1.4	+13.1	+1.9
North Dakota.....	8	68.0	-0.2	+16.5	+2.4
Upper Mississippi Valley.....	11	75.2	+0.2	+4.5	-0.6
Missouri Valley.....	11	74.7	-0.4	+8.3	+1.2
Northern Slope.....	7	67.0	-2.4	+10.4	+1.5
Middle Slope.....	6	75.4	-0.9	+7.3	+1.0
Southern Slope.....	6	78.7	-1.0	+6.6	-0.9
Southern Plateau.....	13	74.7	-3.3	+1.6	+0.4
Middle Plateau.....	9	67.8	-3.7	+2.8	+0.5
Northern Plateau.....	12	65.0	-3.3	+3.2	+0.2
North Pacific.....	7	61.3	-0.7	+1.7	-0.3
Middle Pacific.....	5	64.4	+0.1	+2.0	-0.4
South Pacific.....	4	69.5	-1.1	+2.5	-0.4

#### PRECIPITATION.

Excessively heavy monthly rains, in amounts from 10 to 16 inches, and departing from the normal from +4.00 to +7.50 inches, occurred over portions of southwestern New York, Texas, southwestern Arkansas, eastern Nebraska, and southwestern Iowa. The precipitation was also above the normal on the Georgia and northeastern Florida and Pacific coasts, in southern Arkansas, northern Louisiana, the western parts of the Plateau regions, western North Dakota, and from central New York and the Lower Peninsula of Michigan westward to eastern Colorado and Wyoming. Along the lake shore of Pennsylvania and western Ohio and in southeastern Michigan the departures ranged from +2.2 to +4.2. In the remaining districts the precipitation was below the normal, the greatest departures occurring in the South Atlantic and east Gulf States, the Ohio Valley and Tennessee, and northern Arkansas, where the deficiencies generally amounted to from 2 to 4 inches.

*Average precipitation and departure from the normal.*

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		Inches.	Inches.
New England.....	8	2.45	69	-1.1	-0.9
Middle Atlantic.....	12	3.21	74	-1.1	-2.7
South Atlantic.....	10	4.54	74	-1.6	-9.0
Florida Peninsula.....	8	6.20	95	-0.3	-1.4
East Gulf.....	9	2.92	49	-3.0	-10.0
West Gulf.....	7	4.77	155	+1.7	-4.6
Ohio Valley and Tennessee.....	11	2.57	62	-1.6	-6.6
Lower Lake.....	8	5.43	173	+2.3	+1.3
Upper Lake.....	10	4.16	136	+1.1	-0.8
North Dakota.....	8	1.93	83	-0.4	+1.1
Upper Mississippi Valley.....	11	4.40	116	+0.6	-0.1
Missouri Valley.....	11	5.34	143	+1.6	-0.7
Northern Slope.....	7	1.97	118	+0.3	+0.5
Middle Slope.....	6	2.71	93	-0.2	+1.4
Southern Slope.....	6	3.61	120	+0.6	+2.0
Southern Plateau.....	13	1.08	73	-0.4	-1.8
Middle Plateau.....	9	0.61	120	+0.1	-1.0
Northern Plateau.....	12	1.42	229	+0.8	-0.2
North Pacific.....	7	1.65	174	+0.7	+3.4
Middle Pacific.....	5	0.05	100	0.0	+1.5
South Pacific.....	4	0.23	767	+0.2	-0.4

*In Canada*.—Professor Stupart says:

In all parts of Ontario east of Lake Superior the rainfall was largely above the average amount, especially from the Georgian Bay south to Lake Erie, where in nearly all localities the average was exceeded by

from 3 to 5 inches and over. East of Lake Ontario some excessive plus departures were also recorded, noticeably Peterboro 5.9 inches and Port Hope 5.7 inches. Alberta rainfall was also generally above the average, ranging from 0.2 of an inch in the northern portion to over 2 inches in the southern portion. The rainfall at Calgary of 5 inches, making in all for the three months of May, June, and July no less than 23.7 inches, is a phenomenal amount when it is considered that the average mean annual precipitation for this station is only 15 inches; elsewhere throughout Canada the rainfall was below the average, but in British Columbia, Quebec, and in the greater part of Assiniboia and Saskatchewan to a small extent only. In Manitoba it was from 1 to nearly 2 inches below, and in the Maritime Provinces it was from 1.5 to nearly 3 inches less than the average, several districts in the latter provinces complaining of damage owing to drought.

## HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 4, 14, 15. Arizona, 10, 13. California, 3, 4, 9. Colorado, 4, 5, 6, 9, 11, 12, 13, 17, 18, 19, 21, 25, 26, 27, 30, 31. Connecticut, 14, 15, 17, 21, 28. Delaware, 15, 21. Florida, 8, 12, 13, 20. Georgia, 4, 7, 20, 24. Idaho, 17. Illinois, 8, 14, 16, 17, 18, 22, 24, 28, 31. Indiana, 2, 23, 26. Iowa, 6, 9, 11, 14, 16, 17, 18, 19, 25, 26, 30. Kansas, 1, 4, 5, 6, 7, 17, 20, 21, 22, 26, 28. Kentucky, 4, 15, 30. Louisiana, 15, 21. Maine, 15. Maryland, 6, 15, 18, 20, 25, 27. Massachusetts, 15, 16, 17. Michigan, 2, 7, 8, 10, 15, 16, 17, 19, 20, 24, 26. Minnesota, 4, 5, 7, 11, 12, 16, 22, 23, 24, 25, 29, 30. Mississippi, 14, 26, 29. Missouri, 7, 9, 14, 17, 18, 22, 24, 25, 31. Montana, 3, 12, 17, 27. Nebraska, 4, 5, 6, 7, 12, 13, 14, 17, 19, 24, 25, 26, 29, 30. Nevada, 1, 2, 3, 5, 24, 26. New Hampshire, 14, 15. New Jersey, 5, 15, 16, 18, 22, 24, 25. New Mexico, 10, 17, 19, 20. New York, 5, 6, 7, 14, 15, 17, 21, 22, 23, 24, 27, 28. North Carolina, 4, 5, 7, 10, 18, 20, 21. North Dakota, 6, 13, 16, 19, 23, 24, 25, 28, 29. Ohio, 2, 6, 9, 18, 19, 24, 27, 28. Oregon, 30. Pennsylvania, 3, 4, 5, 12, 15, 17, 18, 19, 21, 24, 25, 26, 28. South Carolina, 3, 7, 11, 20, 21. South Dakota, 4, 5, 6, 7, 10, 11, 12, 13, 23, 30. Tennessee, 5, 9. Utah, 3, 17, 26. Vermont, 14, 21. Virginia, 7, 10, 19, 20, 26. Washington, 1. West Virginia, 6, 7. Wisconsin, 14, 16, 22, 23, 24, 25, 26, 27, 29, 30. Wyoming, 1, 2, 4, 6, 8, 13, 18, 19, 22, 25, 26.

## SLEET.

The following are the dates on which sleet fell in the respective States:

Colorado, 5. Minnesota, 24. Montana, 7, 17.

## HUMIDITY.

The averages by districts appear in the subjoined table:

*Average relative humidity and departures from the normal.*

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England .....	80	+ 1	Missouri Valley .....	70	+ 3
Middle Atlantic .....	75	+ 3	Northern Slope .....	58	+ 6
South Atlantic .....	75	- 5	Middle Slope .....	63	+ 2
Florida Peninsula .....	77	- 3	Southern Slope .....	67	+ 9
East Gulf .....	72	- 7	Southern Plateau .....	37	- 5
West Gulf .....	76	+ 3	Middle Plateau .....	33	+ 1
Ohio Valley and Tennessee .....	70	+ 1	Northern Plateau .....	47	+ 4
Lower Lake .....	76	+ 8	North Pacific .....	70	- 7
Upper Lake .....	76	+ 5	Middle Pacific .....	60	- 7
North Dakota .....	66	0	South Pacific .....	66	+ 3
Upper Mississippi Valley .....	73	+ 5			

## WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

## Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Baltimore, Md. ....	20	70	w.	Mount Tamalpais, Cal. . .	26	54	sw.
Chicago, Ill. ....	17	69	sw.	Do. ....	31	61	nw.
Independence, Cal. ....	2	52	nw.	New York, N. Y. ....	15	52	w.
Lincoln, Nebr. ....	13	50	n.	Point Reyes Light, Cal. .	1	85	nw.
Macon, Ga. ....	11	55	s.	Do. ....	2	90	nw.
Modena, Utah .....	2	58	s.	Do. ....	3	68	nw.
Mount Tamalpais, Cal. .	1	54	nw.	Do. ....	4	62	nw.
Do. ....	2	69	nw.	Do. ....	5	70	nw.
Do. ....	3	56	nw.	Do. ....	6	62	nw.
Do. ....	11	55	nw.	Do. ....	15	56	nw.
Do. ....	15	55	nw.	Port Huron, Mich. ....	27	60	sw.
Do. ....	25	67	sw.	Spokane, Wash. ....	15	52	w.

## SUNSHINE AND CLOUDINESS.

The distribution of sunshine is graphically shown on Chart VII, and the numerical values of average daylight cloudiness, both for individual stations and by geographical districts, appear in Table I.

The averages for the various districts, with departures from the normal, are shown in the table below:

*Average cloudiness and departures from the normal.*

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England .....	5.8	+ 0.9	Missouri Valley .....	4.2	- 0.2
Middle Atlantic .....	5.4	+ 0.6	Northern Slope .....	4.0	+ 0.2
South Atlantic .....	4.5	- 0.7	Middle Slope .....	4.2	+ 0.2
Florida Peninsula .....	5.1	+ 0.1	Southern Slope .....	6.0	+ 2.2
East Gulf .....	5.4	+ 0.4	Southern Plateau .....	2.6	- 0.7
West Gulf .....	5.1	+ 0.9	Middle Plateau .....	2.9	+ 0.9
Ohio Valley and Tennessee ..	4.3	- 0.3	Northern Plateau .....	3.3	+ 0.2
Lower Lake .....	3.8	- 0.7	North Pacific .....	4.6	+ 0.2
Upper Lake .....	5.6	+ 0.9	Middle Pacific .....	2.5	- 0.4
North Dakota .....	3.6	+ 0.7	South Pacific .....	3.2	+ 0.5
Upper Mississippi Valley .....	4.8	+ 0.5			

## ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IV, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

*Thunderstorms.*—Reports of 8,265 thunderstorms were received during the current month as against 7,732 in 1901 and 6,406 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country was most numerous were: 18th, 412; 20th, 377; 19th, 369.

Reports were most numerous from: Ohio, 462; New York, 440; Nebraska, 438.

*Auroras.*—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz: 16th to 24th.

*In Canada:* Thunderstorms were reported as follows: St. John, N. B., 8, 18; Halifax, 9; Grand Manan, 23; Yarmouth, 16, 17, 18, 22, 23; Chatham, 8; Father Point, 8, 13; Quebec, 1, 3, 8, 13, 14, 15, 17, 24, 28, 31; Montreal, 7, 8, 15, 17, 31; Bissett, 13, 14, 15, Ottawa, 15, 17; Kingston, 7, 14, 15; Toronto, 4, 5, 7, 9, 14, 17, 21, 23, 26, 27; White River, 5, 8, 13, 15, 17, 21, 26, 31; Port Stanley, 3, 4, 5, 7, 8, 9, 14, 15, 17, 20, 21, 24, 26; Parry Sound, 7, 15, 26, 31; Port Arthur, 7, 16, 30; Winnipeg, 4, 5, 7; Minnedosa, 2, 4, 5, 6, 13, 14, 19, 29; Qu'Appelle, 3, 13, 15, 23; Medicine Hat, 15; Swift Current, 3, 11, 18, 24, 31; Calgary, 11, 27, 30; Banff, 11, 15, 17, 21, 26, 28, 31; Edmonton, 11, 12, 15; Prince Albert, 11, 13, 22; Battleford, 12, 17, 23, 27, 31; Kamloops, 15; Victoria, 30; Hamilton, Bermuda, 14, 16, 26, 27, 28. No auroras reported from Canada in July, 1902.